Q&A

Q: "Why are sculling boats faster than rowing boats with the same number of athletes?" This question was discussed on a forum http://groups.google.com/group/rec.sport.rowing.

A: Using our database we compared four categories of boats: 2x vs. 2- and 4x vs. 4- (n=2738). Length of the stroke (Table 1) cannot be compared directly because sculling and rowing use different length of the inboard, which causes different oar angles. Comparison of the length of the arc derived using our method (at 6 cm from the top of the handle in sculling and at 15 cm – in sweep rowing) gives very similar numbers between rowing and sculling:

Table 1	Oar angle (deg)		Arc Length (m)		Arc/Height (%)	
Sex	M	W	M	W	M	W
Rowing	**86.9**	**85.0**	**1.56**	**1.54**	**83.7%**	**85.2%**
Sculling	**107.9**	**105.8**	**1.58**	**1.56**	**83.5%**	**89.2%**

Displacement of each body segment was measured in pairs and doubles (Table 2) and their shares in the total length and power were derived:

Table 2	Legs (%)		Trunk (%)		Arms (%)	
Length	M	W	M	W	M	W
Rowing	**35.1%**	**35.3%**	**30.7%**	**32.4%**	**35.1%**	**33.8%**
Sculling	**34.1%**	**34.0%**	**27.4%**	**32.4%**	**39.0%**	**34.9%**
Power	M	W	M	W	M	W
Rowing	**42.7%**	**42.1%**	**34.3%**	**35.2%**	**22.8%**	**22.4%**
Sculling	**43.6%**	**44.4%**	**30.2%**	**33.8%**	**26.3%**	**21.7%**

Male scullers use relatively longer arms drive and produce more power by arms than sweep rowers. In females this difference was less significant. The possible reasons are: geometry of sculling and specifics of the sculling style.

Table 3	Max.Force (N)		Aver.Force (N)		Av.F/Weight (N/kg)	
	M	W	M	W	M	W
HSw	**664.9**	**503.3**	**332.8**	**255.6**	**3.78**	**3.48**
LSw	**576.0**		**291.5**		**4.02**	
HSc	**739.8**	**529.2**	**388.0**	**274.9**	**4.43**	**3.70**
LSc	**699.4**	**465.2**	**370.9**	**250.0**	**5.06**	**4.25**

Force application was found significantly higher in sculling (Table 3). The possible reasons could be:

- When the force measured as a torque at the oar, inside arm in sweep rowing has much shorter leverage and, therefore, produces much less torque and oar bend.
- Sculling is symmetrical and more comfortable.

Rowing power is highly dependent on the stroke rate, so we need to analyse trends (second order polynomial) of this variable as well as trends of its components (length, force and work per stroke). Figure 1 shows that both relative length and force achieve their maximum at 28-30 str/min in sculling and at 32-34 in rowing. Then they decrease and these drops are more significant in sculling. Consequently, the work per stroke and power are higher in sculling at low stroke rates, they are equal at 38 str/min and higher in sweep rowing when the stroke rate increases further. Probably, this is the reason why racing stroke rate is usually higher in sweep rowing than in sculling (RBN 2005/02): on average it is 38.9 in pairs and fours compare to 37.8 str/min in doubles and quads.

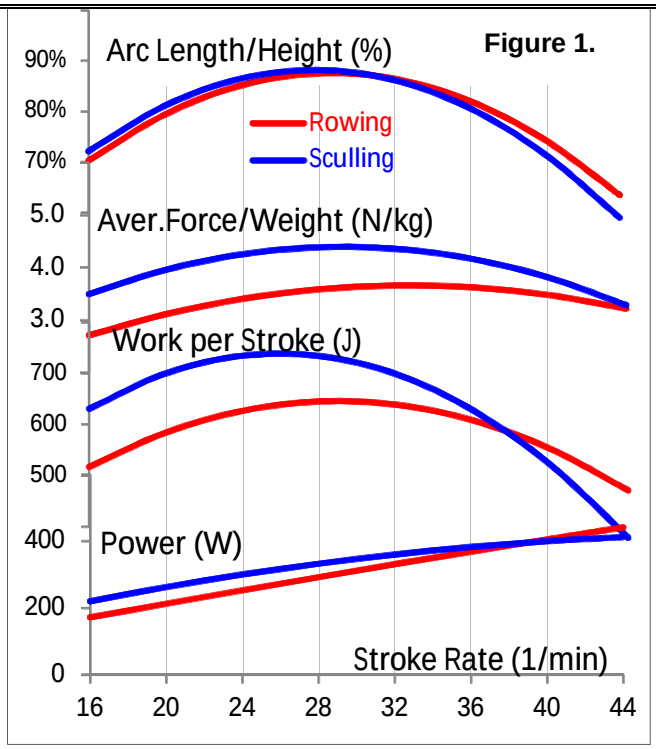

Figure 1.

The chart explains why forces were significantly higher in sculling in Table 3: because the data was averaged over the whole range of the stroke rates. At the racing stroke rates 36-40 str/min the forces are only slightly higher in sculling, but the length became shorter. We can conclude that **power production at the racing stroke rates does not differ significantly between sculling and rowing**.

Table 4.	2- & 2x	4- & 4x	**Blade Efficiency**
Rowing	**79.7%**	**81.5%**	**80.5%**
Sculling	**83.1%**	**85.3%**	**84.6%**

Table 4 shows that the blade efficiency was on average 4.1% higher in sculling boats, which makes them 1.4% faster than similar rowing boats. The reasons could be:

- bigger total area of sculling blades, which causes lower relative pressure and less slippage in the water
- longer angles at catch in sculling, which cause better utilisation of the hydro-lift effect;
- better manoeuvrability of sculling blades, which cause shorter catch and release slips (RBN 2009/10).

Having the difference in speed between similar rowing and sculling boats 3.3% on average (RBN 2009/04), we could speculate that the rest 1.9% difference could be related to the following factors:

- Sweep oars produce higher air drag during recovery because they are longer. We estimate this loss as 0.3%.
- Rowing boats are usually asymmetrical, which cause a wiggle and additional losses in speed (RBN 2009/11).
- Rowing boats have a rudder creating an extra drag.

We can't estimate yet the effect the last two factors and would leave them for future studies.

Finally, **the difference in speed between sculling and rowing can be explained only by higher efficiency of sculling blades and boats**.

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